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ABSTRACT

Presented are highlights from the Survey of Earned Doctorates, focusing on: trends in doctorate production by field, sex, and citizenship; employment of science and engineering (S/E) doctorates; and science and mathematics education doctorates. Approximately 95 percent of the 1982 recipients of the Ph.D. and similar doctorates responded to a survey questionnaire. Data also include information for nonrespondents obtained from public sources. Recipients of first-professional degrees such as the M.D. are not included. Among the findings highlighted are those indicating that: the 1982 S/E doctorate of 17,600 was virtually unchanged from 1981, remaining 7 percent below the peak reached in 1972; that the representation of women continued to grow such that during the last 10 years the number of female S/E doctorates increased by 100 percent, while S/E doctorates awarded to men fell by 20 percent; and that non-U.S. citizens accounted for about 23 percent of new S/E doctorates in 1982. In addition, although doctorates with specialization in science/mathematics education peaked at 364 in 1972, they declined to only 136 in 1982; among those with definite employment commitments in the last three years, about three times as many had commitments to colleges or universities as to elementary or secondary schools. (JN)

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SCIENCE RESOURCES STUDIES HIGHLIGHTS

NATIONAL SCIENCE FOUNDATION WASHINGTON, D.C. 20550 DECEMBER 20, 1983 NSF 83-330

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1982 Doctorate Production Stable in Science and Engineering Fields, But Down in Science and Mathematics Education

The Survey of Earned Doctorates is conducted annually by the National Research Council for the National Science Foundation, the National Endowment for the Humanities, the National Institutes of Health, and the Department of Education.[1] Approximately 95 percent of the 1982 recipients of the Ph. D. and similar doctorates, e.g., Ed. D., responded to the survey questionnaire. The data base includes some information for nonrespondents that was obtained from public sources. Recipients of first-professional degrees, e.g., M.D.'s, are not included.

Highlights

- The 1982 science and engineering (S/E) doctorate production of 17,600 was virtually unchanged from 1981, remaining 7 percent below the peak reached in 1972. S/E doctorates accounted for almost 57 percent of all doctorates in 1982, up from the low point of 54 percent in 1976 and approximately the same level as 10 years ago.

- There were substantial field differences in S/E doctorate production trends over the last decade. The numbers of doctorates awarded increased in only two fields, psychology and life sciences which grew by 38 percent and 9 percent, respectively. There were decreases in the other four major fields, however, ranging from 17 percent in social sciences to 27 percent in mathematical sciences. Engineering doctorate production, which declined by 29 percent between 1972 and 1980 increased for the second successive year and was almost 7 percent higher than in 1980.

- The representation of women among doctorate recipients continued to grow. During the last 10 years the number of women S/E doctorates increased by almost 100 percent, while S/E doctorates awarded to men fell by 20 percent. The combined effect of these opposing trends was an increase in the proportion of S/E degrees awarded to women from 11 percent to 23 percent.

- Non-U.S. citizens accounted for about 23 percent of new S/E doctorates in 1982. This proportion remained essentially constant between 1972 and 1982. Since 1972 there has been a dramatic change in the mix of foreign students with respect to their visa status; those holding permanent resident visas declined by 49 percent and those with temporary visas increased by 40 percent. Non-U.S. citizens' share of all engineering doctorates increased during the decade from one-third to over one-half; in science fields (excluding engineering), their share of doctorates fluctuated within a narrow 17- to 19-percent range.

- The majority of doctorates continued to seek employment following graduation rather than postdoctoral study. The primary source of employment opportunities, however, has been shifting away from the academic sector. In 1982, that sector accounted for 42 percent of the S/E doctorates who had definite employment commitments in the United States, down from 59 percent in 1972. Commitments in business and industry increased from 18 percent to 34 percent during the same period.

- Minorities among U. S. citizens and non-U.S. citizen permanent residents received approximately one-tenth of the S/E doctorates awarded in 1982, a level that has been stable since 1978. Asian Americans earned 55 percent of the degrees awarded to minorities in 1982, but their share has decreased slightly in recent years.

- In addition to S/E doctorates there is a relatively small group of education doctorates with specialization in mathematics and science. New doctorates in these specialties peaked at 364 in 1972 but declined to only 136 in 1982. Among those with definite employment commitments in the last three years, about three times as many had commitments to colleges or universities as to elementary or secondary schools.

[1] Additional information is available from the National Research Council's annual publication series, *Summary Report: Doctorate Recipients from U.S. Universities* (Washington, D.C.).

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Prepared in the Supply and Education Analysis Group, Division of Science Resources Studies

Trends in Doctorate Production

Doctorate production in all fields reached a peak of almost 34,000 in 1973 and then declined for several years. The 31,000 doctorates awarded in 1982 were 8 percent below the 1973 level. S/E degrees peaked in 1972 at 19,000 and then dropped to 17,000 by 1978. A slight recovery to 17,600 in 1981 and 1982 left S/E degrees 7 percent below the 1972 high. In contrast, the production of S/E degrees at the bachelor's and master's level peaked in 1974 and 1977, respectively.[2]

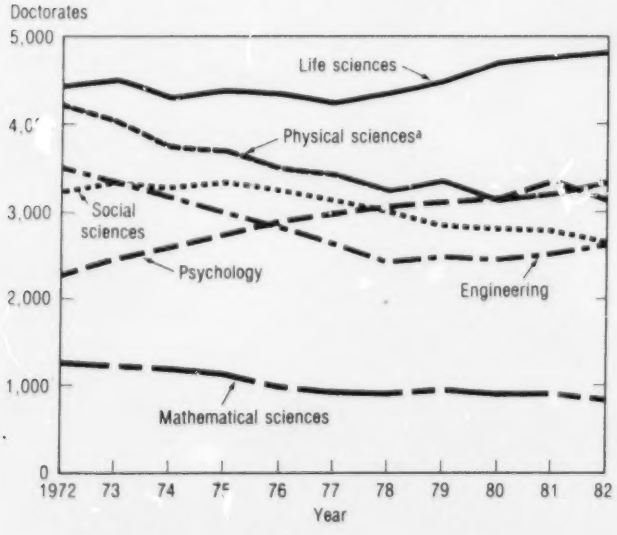
S/E degrees accounted for almost 57 percent of all doctorates in 1982. The S/E proportion of all doctorates declined from 65 percent in 1962 to 54 percent in 1976. It has been in a gradual uptrend since that time.

FIELD

The trends in doctorate production differed substantially among the major fields (chart 1). Doctorates in psychology reached an all-time high of 3,300 in 1981 and were 38 percent greater in 1982 than in 1972. Life sciences reached a new peak in 1982, 9 percent higher than 10 years earlier. Degrees in the other major groups—mathematical sciences, engineering, and physical sciences—were substantially below their 1972 levels, by 27 percent, 25 percent, and 21 percent, respectively. Doctorates in life sciences exceeded those in physical sciences for the first time in 1971 when each accounted for approximately 24 percent of all S/E doctorates. The life sciences share is now 27 percent of all S/E degrees compared to 19 percent for physical sciences. Degrees in psychology increased from a 12-percent share to 18 percent during the last 10 years.

[2] This decline is also reported in National Science Foundation, "Trends in Science and Engineering Degrees, 1950 through 1980," *Science Resources Studies Highlights* (NSF 81-320) (Washington, D.C., October 7, 1981). That report utilized degree data from the National Center for Education Statistics (NCES). Inconsistencies between the Survey of Earned Doctorates (SED) and the NCES data may occur because of differences in data collection methods. Individuals furnish the SED data while institutions furnish the NCES data.

Chart 1. Science/engineering doctorate production by field



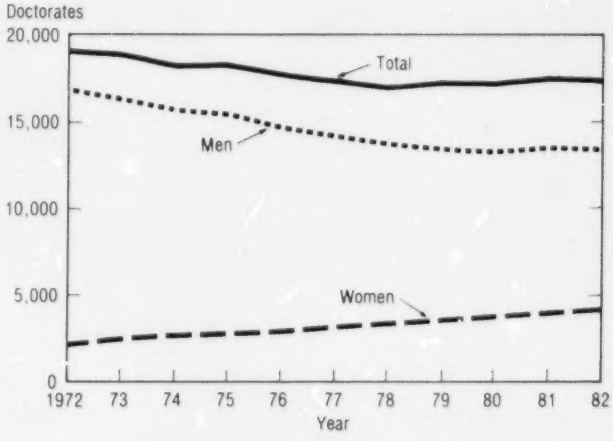
[a]Includes earth and environmental sciences.
SOURCE: National Science Foundation

SEX

The number of S/E doctorates awarded to women grew from 2,100 in 1972 to over 4,100 in 1982. Between 1981 and 1982, however, the number increased by only 3 percent compared to an average annual growth rate of 7 percent for the 1972-82 period (chart 2). During the same time, S/E doctorates awarded to men fell by 20 percent to 13,500. The share of S/E doctor's degrees awarded to women increased from 11 percent in 1972 to over 23 percent in 1982.

The percentage of S/E doctorates awarded to women increased in every major field and in 1982 ranged from less than 5 percent in engineering to 25 percent in life sciences, 27 percent in social sciences, and 45 percent in psychology. The largest numbers of doctorates awarded to women were in psychology and life sciences; the continued growth of degrees in these fields, noted above, is attributable almost entirely to the increase in the number of women.

Chart 2. Science/engineering doctorate production by sex



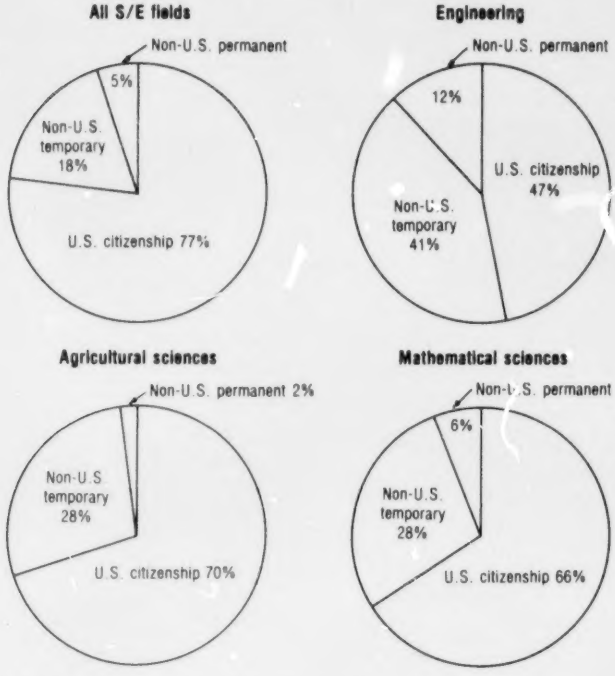
SOURCE: National Science Foundation

CITIZENSHIP

Doctoral education in the United States continues to attract substantial numbers of foreign citizens. Most of the growth occurred prior to 1972 when non-U.S. citizens received 3,800 S/E doctorates and the number has since remained in the 3,500-4,000 range. S/E doctorates earned by U. S. citizens, however, declined from 14,900 in 1972 to 13,000 in 1982. As a result, the proportion of non-U.S. citizens among S/E doctorates grew from 20 percent to 23 percent over this 10-year period (chart 3).

Non-U.S. students include those with permanent and temporary visas. The number of S/E doctorates received by non-U.S. citizens with permanent visas reached an all-time high of more than 1,600 in 1972 but has steadily declined since to about half as many. The number of S/E doctorates received by holders of temporary visas, however, reached a peak of over 3,000 in 1982, an increase of 40 percent in the last 10 years. In 1982, non-U.S. citizens with temporary visas received 14 percent of all science doctorates (excluding engineering), and those with permanent visas, 4 percent. Engineering attracts more foreign citizens than any other

Chart 3. Citizenship status of 1982 science/engineering (S/E) doctorates for fields with substantial foreign participation



NOTE: Percentages based on doctorate whose citizenship is known.
SOURCE: National Science Foundation.

major field. Non-U.S. citizens earned one-third of all engineering doctorates in 1972, and over one-half in 1982. In engineering the number of non-U.S. doctorate recipients with permanent resident visas declined by 52 percent between 1972 and 1982 while those with temporary visas increased by 98 percent. Other fields in which foreign citizens accounted for relatively large shares of doctorates in 1982 were mathematical sciences, 34 percent, and agriculture, 30 percent—the latter down from 38 percent in 1981.

Increasingly, foreign citizens with temporary visas are staying in the United States for postdoctoral study or employment. In 1982 about one-fourth who received doctorates in science fields and over one-third of those who received doctorates in engineering had definite commitments for postdoctoral study or employment in the United States. Despite the 49-percent decline since 1972 in the foreign S/E doctorate recipients with permanent visas, the total number of non-U.S. citizens with definite commitments in the United States increased from 1,160 in 1972 to 1,375 in 1982.

Employment of S/E Doctorates

Employment patterns for new doctorates changed over the past decade, reflecting in part decreasing opportunities in the academic sector. In 1982, both S/E and non-S/E new doctorates were less likely to obtain traditional academic positions, paralleling a shift in employment opportunities for the total S/E doctoral labor force.[3] Of the S/E doctorates with definite employment commitments (a signed contract or similar arrangement) in the United States, only 42 percent indicated that they would be employed at a college or university in 1982, compared to 59 percent in 1972. Definite commitments in business and industry, the principal nonacademic employer, increased from 18 percent to 34 percent during the 1972-82 period. Commitments for Government employment declined from 17 percent to 13 percent. Only 2 percent—primarily psychologists—had contracts with elementary or secondary schools. The major fields with the highest proportions of new doctorates with employment commitments at colleges and universities in 1982 were social and mathematical sciences; the fields with the highest proportions working in business and industry were physical sciences and engineering. Although the shifts in employment sectors applied to both men and women, colleges and universities continued to hire a greater share of women in 1982 than did business and industry—47 percent versus 20 percent.

Science and Mathematics Education Doctorates

In addition to new S/E doctorates, there are also doctoral graduates in education with specialization in teaching science or mathematics.[4] In 1982 there were 86 science education and 50 mathematics education doctorates. The number in science education is small relative to the number of natural science degrees, but the number of degrees in mathematics education equalled about one-tenth of the doctorates in mathematics during the 1972-82 period.[5]

The trends in mathematics and science education doctoral production paralleled S/E trends since 1960 by peaking in 1972 and then declining (chart 4). The wane in mathematics and science education, however, was more severe, particularly in recent years. In 1982 the numbers of science and mathematics education doctorates were 60 percent and 68 percent, respectively, below the 1972 levels.

The participation of women in these two teaching fields in the last 10 years has been greater than that in natural sciences, 23 percent compared to 16 percent. U.S. citizens earned over 90 percent of the mathematics and science education doctorates each year until 1976. In the last few years, however, the number of U.S. citizens declined and the proportion of non-U.S. citizens grew to 22 percent by 1982. Over 85 percent of the non-U.S. citizens receiving mathematics and science education doctorates during 1980-82 possessed temporary visas. In comparison, non-U.S. citizens have received approximately 20 percent of the doctorates in natural sciences since 1972.

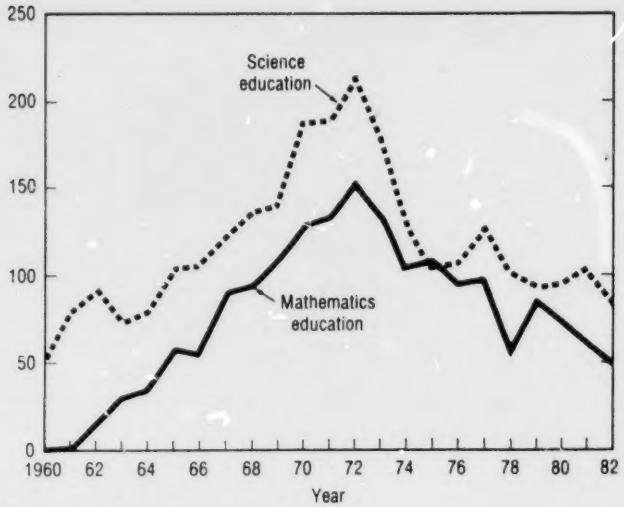
Mathematics and science education doctorates are clearly different from S/E doctorates in terms of time elapsed between receipt of the bachelor's and doctor's degrees, and in their ages at receipt of their doctorate. During the years 1980-82 the median time lapse for the two education fields

[3] National Science Foundation, "Growth in Employment of Science and Engineering Doctorates Continues, Led by Computer Scientists," *Science Resources Studies Highlights* (NSF 82-328) (Washington, D.C., November 30, 1982).

[4] This discussion relates to mathematics and science education only because of space limitations. Doctorates are also awarded in agriculture education and social science education but they are fewer in number.

[5] Natural sciences are defined herein to include life sciences, physical sciences, and mathematics.

Chart 4. Doctorate production in mathematics and science education



SOURCE: National Science Foundation

was 13.6 years, whereas the median time lapse for all S/E doctorates during the same period was 7.7 years. As a consequence, the science and mathematics education doctorates were about six years older than the S/E doctorates. One of the reasons for the greater time lapse is that many graduate programs in education require prior teaching experience for admission. The longer time lapse also suggests the likelihood that mathematics and science education doctorates were part-time graduate students and already employed full-time. The support patterns of the science and mathematics education doctorates are consistent with the suggestion that many were employed while they were in graduate school. More than half of the recent science and mathematics doctorates relied primarily on self-support to finance their graduate education. Less than 6 percent of the U.S. citizens among the 1982 group received their primary support from Federal sources, compared to 18 percent of those receiving doctorates in S/E fields.

Very few of the mathematics and science education doctorates pursue postdoctoral study, and over the years a relatively high proportion of them had definite employment commitments in the United States at the time of graduation. In 1982, the number with such commitments equalled 65 percent of the number of U. S. citizens awarded degrees in these two fields. The high employment commitment rates further support the supposition that many of these doctorates were fully employed prior to completion of their graduate studies. As may be expected the great majority of these education doctorates have their commitments with either higher education or elementary and secondary schools. In both mathematics and science education, the number of doctorates obtaining appointments in colleges and universities has fallen severely during the past decade—from almost 200 in 1972 to about 40 in 1982. The numbers with commitments to elementary and secondary schools showed a smaller decline. In the last 5 years only 36 mathematics and 68 science education doctorates had contracts with elementary and secondary schools, down from 52 and 96, respectively, in the preceding 5-year period. In 1982, there were 20 mathematics and 18 science education doctorates with commitments to colleges and universities, but only 5 and 13, respectively, to elementary and secondary schools.

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